



## ผลของระยะเวลาในการประคบด้วยแผ่นร้อนต่ออาการปวดและความสามารถในการยืดออกของกล้ามเนื้อเหยียดหลัง ในผู้ที่มีอาการปวดหลังส่วนล่างระยะเรื้อรังแบบไม่จำเพาะ

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### บทคัดย่อ

เพื่อเปรียบเทียบผลของระยะเวลาในการประคบด้วยความร้อนตื้นที่หลังส่วนล่างต่ออาการปวดและความสามารถในการยืดออกของกล้ามเนื้อเหยียดหลังในผู้ที่มีอาการปวดหลังส่วนล่างระยะเรื้อรังแบบไม่จำเพาะ ผู้ที่มีอาการปวดหลังส่วนล่างระยะเรื้อรังแบบไม่จำเพาะจำนวน 30 รายได้รับการสุ่มเพื่อแบ่งออกเป็น 3 กลุ่ม คือกลุ่มควบคุมซึ่งไม่มีการประคบร้อน กลุ่มที่ได้การประคบร้อน 15 นาที และกลุ่มที่ได้การประคบร้อน 30 นาที โดยทำการประคบที่บริเวณหลังส่วนล่างในท่านอนหงาย ผู้วิจัยวัดอาการปวดและความสามารถในการยืดออกของกล้ามเนื้อเหยียดหลัง ก่อนและหลังการประคบโดยทันที กลุ่มที่ได้รับการประคบ 15 และ 30 นาทีมีอาการปวดลดลงภายหลังการประคบอย่างมีนัยสำคัญทางสถิติ แต่ความสามารถในการยืดออกของกล้ามเนื้อเหยียดหลัง ไม่พบความแตกต่างในทั้ง 3 กลุ่ม การประคบด้วยความร้อนตื้นมีผลลดปวดโดยทันทีภายหลังการประคบ แต่ไม่พบความแตกต่างของความสามารถในการยืดออกของกล้ามเนื้อเหยียดหลัง ซึ่งควรได้รับการรักษาโดยวิธีอื่นเพิ่มเติม

คำสำคัญ: แผ่นร้อน, ระยะเวลา, ปวดหลัง



## Effects of duration of hydrocollator pack application on pain and back extensor muscle extensibility in individuals with chronic nonspecific low back pain

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### Abstract:

**Objectives:** This study aimed to investigate the different durations of superficial heating on pain and back extensor muscle extensibility in individuals with chronic low back pain

**Materials and methods:** Thirty individuals with chronic nonspecific low back pain were randomized into one of 3 intervention groups: no heating, 15-min heating, or 30-min heating in lying position. Pain and back extensor muscle extensibility were measured before and immediately after the intervention session.

**Results:** After 15-minute and 30-minute heating, pain significantly decreased but back extensor muscle extensibility was indifferent among 3 groups.

**Conclusion:** Superficial heating has an immediate effect in pain reduction. While, back extensor muscle extensibility is not different, it is therefore suggested to consider other additional interventions.

**Keywords:** Hot pack, Duration, Back pain

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## Introduction

Low back pain (LBP) is one of musculoskeletal problems with highest prevalence<sup>(1-3)</sup>. According to the diagnostic triage, LBP could be divided into nonspecific LBP, radicular LBP, and specific LBP<sup>(4)</sup>. Nonspecific LBP has highest prevalence<sup>(5)</sup>. The most common problems of nonspecific LBP are pain, limited active range of motion (AROM), and disability<sup>(5,6)</sup>. There are many interventions used nowadays for nonspecific LBP such as manual therapy, therapeutic exercise, electrical modalities, and heat or cold modalities<sup>(7)</sup>. Among these modalities, hydrocollator pack was most frequently used<sup>(8)</sup>.

Hydrocollator pack is widely popular among physical therapists for therapeutic purposes including pain reduction and muscle relaxation<sup>(9-13)</sup>. Physical therapists use hydrocollator pack to alleviate pain and to promote tissue extensibility<sup>(13-16)</sup>. Hydrocollator pack is a superficial heating method that can increase tissue temperature within 1-3 cm depth and has less precautions and contraindications than deep heating devices<sup>(13, 17-19)</sup>.

The instructions of the use of hydrocollator pack application have been generally provided but it is limited in suggestion about the duration of application. Previous study reported that 15-minute superficial heating was effective in increasing AROM of ankle dorsiflexion in healthy subjects<sup>(20)</sup>. Anyhow, AROM of ankle dorsiflexion is mainly influenced by plantarflexor muscle. It is different for low back because of different group of muscles and joint components. In addition, there is limited in knowing of the effectiveness of hydrocollator pack application in pain reduction and muscle extensibility promotion in individuals with nonspecific LBP.

This study is therefore interested to investigate the effect of duration of hydrocollator pack application on pain and back extensor muscle extensibility in individuals with chronic nonspecific low back pain.

There were three different durations: no heating, 15-, and 30-minute heating. It was surmised that 15- and 30-minute heating have significant differences in pain and back extensor muscle extensibility compared to no heating.

## Materials and Methods

This study was an experimental design, the research setting and the LBP patients sample were at Physical Therapy Center, Faculty of Physical Therapy, Mahidol University. Mahidol University Institutional Review Board (MU-IRB) approved this study.

### Subjects

Thirty chronic LBP patients (21 women, 9 men) with an age range from 25-50 years were asked for participation. The characteristics of all subjects are shown in **Table 1**. The subjects were excluded if they had any obvious musculoskeletal or neurological problems affecting their lower extremities, pregnancy, prior spinal surgery, known lumbar disc hernia, diagnosed joint inflammatory disease, neurological involvement, cancer, or receiving other forms of treatment rather than physical therapy such as back pain injection, steroids use, and any medical conditions that could be aggravated by superficial heating.

### Procedure

After interview and general physical examination, the eligible patient signed informed consent. Baseline (pre) assessment of pain and active range of motion (AROM) were operated by the measurement researcher (SK) who is a physical therapist with more than 10 years of experience in musculoskeletal physical therapy, and was blinded to the intervention. All patients were then randomly divided into 3 groups; no heating, 15-minute, and 30-minute heating by drawing lots. The hydrocollator pack was prepared and presented by the intervention researcher (PP) who was blinded to the measurements. After the intervention, post assessment of pain and AROM were immediately

measured again.

For pain measurement, Visual Analog Scales (VAS) with 10-cm horizontal line anchored by 'no pain' on the left end and 'worst pain imaginable' on the right end<sup>(21)</sup> was used. The patient reflected their magnitude of pain with a mark on the line.

For AROM measurement, flexion direction was measured representing back muscle extensibility. By which, Modified-modified Schober technique (MMST), tape method<sup>(22)</sup> was used. Briefly, the starting position of measurement was in standing with hips and knees in neutral position; the distance between feet equals to shoulder's width. The measuring tape was aligned from baseline landmark (at the midpoint between both sides of PSIS) to 15 cm above the baseline landmark. The patients then moved both hands down as far as possible while keeping knees extended. The measurement researcher recorded the new distance between two landmarks in full flexion and then subtracted from 15 cm. The training session was provided to the measurement researcher before the study. For reliability, intra-tester reliability of the measurement researcher in AROM flexion was excellent, with intraclass correlation coefficients ( $ICC_{3,1}$ ) of 0.997, the standard error of measurement (SEM) 0.001.

## Intervention

No heating group, the patients did not receive any heating intervention. They were informed to rest in supine lying position on a plinth for 30 minutes.

Fifteen-minute heating group, the patients were asked to rest in supine lying position on a plinth for 15 minutes first, and then the intervention therapist immediately placed a 36 x 54 cm hydrocollator pack covered with 2 layers of toweling under the subject's back muscle area covering from the posterior superior iliac spine (PSIS) level towards upper back. The subjects were in supine lying position during hydrocollator pack application for another 15 minutes.

Thirty-minute heating group, the patients were in supine lying position together with hydrocollator pack application for 30 minutes. The methods of hydrocollator pack preparation and application was as well as the 15-minute group but different duration.

The 15- and 30-minute heating groups, for safety and therapeutic purpose, the patients felt only comfortably warm during heating. They were also informed to keep the same position and not allowed to move away from a hydrocollator pack. They were also instructed to ask the intervention researcher any time if toweling adjustment was needed entire duration of heating for comfortable warmth. After heating, the subjects slowly stood up for the measurements. The hydrocollator pack used in this study was preheated for 24 hours at least in a heater at 80°C with laboratory room temperature controlled at 25°C.

## Data analysis

All statistical analyses were done by using SPSS program for Windows, version 13. In this study, Kolmogorov-Smirnov Goodness of Fit-test showed that the data were normally distributed. One way Analysis of Variance (ANOVA) was used for subjects' characteristics. Repeated measure ANOVA was used to compare main effect of time and between-group effect among three groups. Bonferroni test was further used for post-hoc analyses. The level of statistical significance was set at 95% ( $P < 0.05$ ).

## Results

The subjects' characteristics regarding gender, age, weight, height, BMI, LBP duration, Oswestry Disability Index (ODI), and low back skinfold thickness have been shown in **Table 1**. There was no significant difference among three groups for the characteristics. The baseline data of pain and AROM in three groups was similar without statistical significance,  $F = 1.420$ ,  $P = 0.259$  and  $F = 1.420$ ,  $P = 0.259$  respectively.

The values of baseline (pre), and after intervention (post) for pain and AROM were reported in **Table 2** and **3** respectively. The repeated measure ANOVA for pain showed statistically significant differences for within-group comparison,  $F = 23.445, P < 0.001$  and interaction,  $F = 108.905, P < 0.001$ , while there was no significant difference for between-group

comparison,  $F = 2.711, P = 0.085$ . Post-hoc analysis showed significant differences between pre and post in 15-minute group and 30-minute group.

For AROM, the results showed no significant differences for within-group comparison,  $F = 0.060, P = 0.808$ , between-group comparison,  $F = 2.953, P = 0.069$ , nor interaction,  $F = 0.651, P = 0.529$ .

**Table 1** Subjects characteristics (n = 30 totally, 10 of each group)

Parameters	No heating	15-minute	30-minute	P - value
Gender (female: male)	7:3	8:2	6:4	-
Age (years)	38 (7.9)	32.9 (7.5)	32 (5.1)	0.138
Weight (kg)	62.3 (5.3)	58 (9.3)	62.2 (9.1)	0.410
Height (cm)	162.9 (5.5)	160.8 (7.2)	164.4 (7.0)	0.486
BMI (kg/m <sup>2</sup> )	23.5 (2.7)	22.3 (2.4)	22.9 (3.2)	0.633
LBP duration (months)	36.7 (33.0)	21.6 (36.7)	16.4 (14.5)	0.301
ODI (%)	18.2 (12.2)	13.2 (7.0)	13.0 (5.7)	0.339
Low back skinfold thickness (cm)	1.9 (0.7)	1.7 (0.4)	1.8 (0.9)	0.833

Data presented as means (SD).

**Table 2** VAS for pain (cm) before and after the intervention in three groups

Group	Baseline (pre)	After (post)	posthoc P - value between pre and post
No heating	3.68 (1.83)	3.18 (1.71)	0.160
15-minute	3.27 (1.42)	1.49 (1.53)	< 0.001*
30-minute	4.79 (2.77)	2.62 (1.58)	0.024*

Data presented as means (SD).

**Table 3** AROM (cm) for lumbar flexion before and after the intervention in three groups

Group	Baseline (pre)	After (post)
No heating	5.42 (0.84)	5.17 (0.99)
15-minute	5.49 (1.13)	5.60 (1.06)
30-minute	5.81 (1.28)	5.90 (1.29)

Data presented as means (SD).

## Discussion

Hydrocollator packs are widely used by physical therapists worldwide, especially in Thailand<sup>(8)</sup> for treating individuals with chronic nonspecific LBP. Its therapeutic effects include pain reduction and tissue extensibility enhancement<sup>(13)</sup>. However, the evidence regarding the effectiveness of hydrocollator pack application in individuals with chronic nonspecific LBP is limited. This study therefore focused on its effects regarding pain and back extensor muscle extensibility. The characteristics of the subjects in this study, age, weight, height, BMI, and duration of LBP in 3 groups had no difference. The low back skinfold thickness was similar among 3 groups, 1.7 – 1.9 cm, which is not too thick for hydrocollator pack application because superficial heating can increase tissue temperature within 1-3 cm depth<sup>(13,18)</sup>. The baseline ODI and pain in 3 groups were similar, ranged from 13 – 18.2 % and 3.27 – 4.79 cm respectively, representing the severity of LBP from mild to moderate.

The findings of this study, for pain reduction, it was found that both 15- and 30-minute heating has statistically significant difference. The magnitude of reduction for 15- and 30-minute is 1.78 cm and 2.17 cm on 10-cm scale of VAS respectively. Anyhow, a previous study reported clinical significance in term of minimum clinically important difference (MCID) of pain reduction in individuals with back problems. That study indicated 2.1 cm for clinically significant reduction<sup>(23)</sup>. Therefore, in this study, it is only 30-minute heating that can achieve both statistical significance and clinical significance. Surprisingly, we also found mild change in pain reduction in no-heating group, 0.5 cm. Although, this small number did not exceed statistical nor clinical significance, it reflected that only 30-minute rest in lying position may has an effect in pain reduction, perhaps placebo or truly relaxation, by which further investigation is needed to prove. It is not likely to be that the 0.5-cm difference in no-

heating group was from measurement error since the measurement reliability was excellent, and the previous studies also affirmed the excellent reliability of MMST measurement for back flexion<sup>(24,25)</sup>.

For back extensor muscle extensibility, in this study, AROM in flexion was measured to represent back extensor muscle extensibility. The finding showed that there was no any group increasing AROM significantly. This result was different to previous studies<sup>(20,26)</sup>. Even though, the improvement of AROM after heating is proposed according to connective tissues theory and neuromuscular control basis. Anyhow, this study proved that heating has small effect size on back extensor muscle extensibility or it is needed for 2,102 subjects to possibly yield to significant difference with 0.9 power, and 0.05 f value. Therefore, it is possible to postulate that 15- or 30- minute of hydrocollator pack application is not enough for increasing AROM in back flexion. The increase in AROM in back flexion is likely to be due to other interventions, for example, spinal mobilization<sup>(27,28)</sup>.

The variables in this study, we measured only pain and AROM because we hypothesized that single-session of hydrocollator pack application should have immediate effect on pain and AROM. Anyhow, other back-pain relevant variables such as functional disability, psychosocial factors, sick leave, treatment expenses, and the others, should also be considered in cohort LBP studies.

All subjects in this study were interviewed about the activity in daily living to affirm that the subjects were sedentary people who were not athletes nor perform a heavy activity. Therefore, the interpretation of the result covers sedentary males and females with chronic nonspecific LBP. The result in this study cannot be generalized to other kinds of LBP such as radicular LBP or specific LBP, by which other interventions rather than hydrocollator pack should be more appropriate. Another limitation, this study investigated

the immediate effect of single-session hydrocollator pack application. Its long-term effect was not in our scope.

## Conclusion

Single session of 15- and 30-minute hydrocollator pack application had an immediate effect on pain reduction but not AROM increase in individuals with chronic nonspecific LBP. However, to meet both clinical and statistical significance for pain reduction, 30-minute superficial heating was proposed. This study proved that hydrocollator pack application has analgesic effect, it is however suggested that other relevant adjunctive interventions are also needed for individuals with chronic nonspecific LBP to solve other problems such as AROM limitation and the others.

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